Journal of Agricultural Science and Food Technology
Vol. 1 (7), pp. 94-100, December, 2015
ISSN: 2449-1815
Research Paper
http://pearlresearchjournals.org/journals/jmbsr/index.html

Abundance and Distribution of Invasive Alien Plant Species in Illu Ababora Zone of Oromia National Regional State, Ethiopia

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Accepted 30 October, 2015

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ABSTRACT

The study was conducted to determine the invasive alien plant species (IAPS) composition, abundance and geographical distribution in the Illu Ababora Zone. Data were recorded in a total of 67 Way Points at 10 Km interval on the roadsides using GPS60 instrument. During the study, a total of 16 IAPS, namely, *Parthenium hysterophorus, Cuscuta campestris, Lantana camara, Cirsium vulgare, Mimosa invisa, Xanthium strumarium, Xanthium spinosum, Senna occidentalis, Senna didymobotra, Acanthus pubescens, Opuntia stricta, Tapinanthus globiferus, Argemone ochroleuca, Psidium guajava, Ipomeoa spp., and Caesalpinia spp.* were recorded. Of the species intercepted *C. campestris, T. globiferus and C. vulgare* were recorded with more than 40% frequency while others were observed with less than 20% frequency. The abundance and distribution of *P. hysterophorus, L. camara,* and *M. invisa* was found less and limited to roadside and around habitation in and/or near the towns but in a phase of rapid population growth. The study proved that most of the IAPS have been introduced to the Zone. Therefore, further research is needed to quantify the increases in species abundance, distribution and socio-economic impact, which may support planning on prevention and management measures to combat against invasive in the study area.

Key words: Ethiopia, Invasive Alien Plant Species, Abundance and Distribution.

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INTRODUCTION

Biological invasions are attracting extensive attention from ecologists because of their significant ecological impacts and economic costs worldwide. They are increasingly recognized as a key problem of conservation of biological diversity (Reichard and White, 2003). Invasion by plant species poses a major threat to native plant communities and alters fundamental structures and functions of ecosystems. Recently, it has been proofed that some invasive alien plant species (IAPS) are spreading at an alarming rate and exerting negative impacts on agricultural lands, rangelands, national parks, waterways, lakes, rivers, power dams, roadsides and urban green spaces in Ethiopia (EARO, 2003). Among several IAPS in the country, *Parthenium hysterophorus, Eichhornia crassipes, Prosopis juliflora, Lantana camara* and the parasitic weeds - *Striga*, *Orobanche* and *Cuscuta* species were considered an emerging issue for the country (EARO, 2004b). These species are spreading from place to place by different mechanisms and aggressively invading natural habitats, rangelands and water bodies (EARO, 2004b; Hailu et al., 2004; Kassahun, 1999; Kassahun et al., 2004). Taye et al. (2007) reported that *P. hysterophorus* was found on the market area and wasteland of some districts of the Illu Ababora Zone.

The detailed background study of IAPS was lacking despite most scholars had been trying to prioritize them. The environmental policy of Ethiopia (EPE), the research

Table 1. Quantitative estimation of IAPS abundance.

S/N	Abundance	Description	Cover percentage
1	Very abundant	If the area is covered by extensive stands	> 75
2	Abundant	If there are many clumps or stands	50 – 75
3	Frequent	If there are many sightings of single plants or small groups	30 – 50
4	Occasional	If there are a few sightings of one or a few plants	15 – 30
5	Rare	If there are one sighting of one or a few plants	5 – 15
6	Present	Abundance uncertain	1 – 5
7	Absent	If there is no IAPS	0

Source: Wittenberg et al. (2004).

policy of the Ethiopian Institute of Agricultural Research (EIAR), and other policy and strategy documents acknowledge the eminent threat posed by IAPS on the country's biodiversity and ecosystem at large (Ababu et al., 2004; EARO, 2004d; Amha, 2006). In general, in Ethiopia, there is an urgent need to develop and widely utilize integrated management systems for IAPS against specific plant species. The accurate knowledge of the distribution and relative abundance of IAPS is needed for application and maximization of the efficacy of control measures. However, there is paucity of information with regard to the species composition, abundance and distribution of IAPS in Ethiopia in general and the Illu Ababora Zone in particular. Therefore, the present investigation was carried out with the objective to determine the species composition, abundance and distribution of IAPS in the Illu Ababora Zone.

MATERIALS AND METHODS

Survey on the Abundance and Distribution of IAPS in Illu Ababora Zone

Field data collection was conducted during the 2009 cropping season; September to December. During the survey a total of 67 sampling points were taken in eighteen Districts (that is, Ale, Bedele, Bilo Nopha, Borecha, Bure, Chawaqa, Chora, Dabo Hana, Dedesa, Dega, Didu, Gechi, Hurumu, Halu, Meko, Metu, Sale Nono and Yayu) of the Illu Ababora Zone which is located at $8^{o}16'$N and $35^{o}45'$E. Visual observation of the species abundance and distribution was made at every 10 Km intervals along gravel and asphalt roads of the study area, which was easily accessible by car. At each 10 Km interval point data, the number of IAPS observed was recorded and their abundance was determined depending on expert judgment (modified from Wittenberg et al., 2004) (Table 1). All the field data including GPS reading (waypoint, longitude and latitude coordinates, and altitude) were noted. The presence/absence of the species was also recorded.

Data Analysis

The biophysical data obtained from the field were analyzed using Ms-Excel, and ArcGIS 9.1 version software. The data from Ms-Excel were imported into ArcGIS. In ArcGIS, spatial analyst components were used to synthesize distribution maps of IAS in the covered Districts of the Zone. The species distribution (by frequency) and abundance (by cover percentage) at Zonal level were computed on MS-EXCEL from the biophysical data obtained from the field. Species frequency was computed as percentage of data points in which the specific species found from the total data points (67).

RESULTS

Invasive Alien Plant Species (IAPS) Composition

The result of the study showed that a total of sixteen IAPS representing 9 families were recorded in the Illu Ababora Zone. Most of the IAPSs were found growing on roadsides and around habitation in and/or near the towns of the Districts (Table 2). This suggests that the introduction and distribution of IAPS are related to city dwellers and transportation.

Abundance and Distribution of IAPS

The biophysical survey showed that *Senna dedymobotra, Acanthus pubescens, Ceasalpinia spp, Cirsium vulgare, Tapinanthus globiferous* and *Cuscuta campestris* were highly distributed in the Zone with the frequency of 60, 58, 52, 45, 45 and 42, respectively while the other species were found less distributed in the zone having the frequency of less than 20% (Table 2). The result revealed that most of the IAPS had rare abundance except five species (that is, *S. dedymobotra, A. pubescens, Ceasalpinia spp*., C*. vulgare, C. campestris* and *T. globiferus*) which had occasional to frequent abundance in the Zone. Apart from parasitic higher plants

Table 2. IAPS frequency and cover percentage in the Illu Ababora Zone.

S/N	Scientific name	Infested habitat	Frequency	Cover percentage
1	*Acanthus pubescens*	RS, Rl, Cl, Af and Pl	58	36
2	*Argemone ochroleuca*	Rs and Ah	10	4
3	*Caesalpinia sp.*	Rs, Ah and Af	52	32
4	*Cirsium vulgare*	Rs, Rl, Cl and Wl	45	22
5	*Cuscuta campestris*	Cropland	42	23
6	*Ipomeoas sp.*	Rs, Cl and Af	19	9
7	*Lantana camara*	Ah, Rs and Rl	13	9
8	*Mimosa invisa*	Rs and Rl	6	4
9	*Opuntia stricta*	Ah	6	1
10	*Parthenium hystrophorus*	Rs and Wl	19	11
11	*Psidium guajava*	Rs, Rl and Af	15	26
12	*Senna didymobotra*	Rs, Rl and Wl	60	31
13	*Senna occidentals*	Rs and Rl	21	6
14	*Tapinanthus globiferus*	Pl	45	21
15	*Xanthium spinosum*	Rs and Wl	6	3
16	*Xanthium strumarium*	Rs and Wl	12	6

Infested Habitat: (Rs-Roadside, Rl-rangeland, Cl-cropland, and Af-around forest, Wl-Waste land, Ah-Around habitation and Pl Plantation).

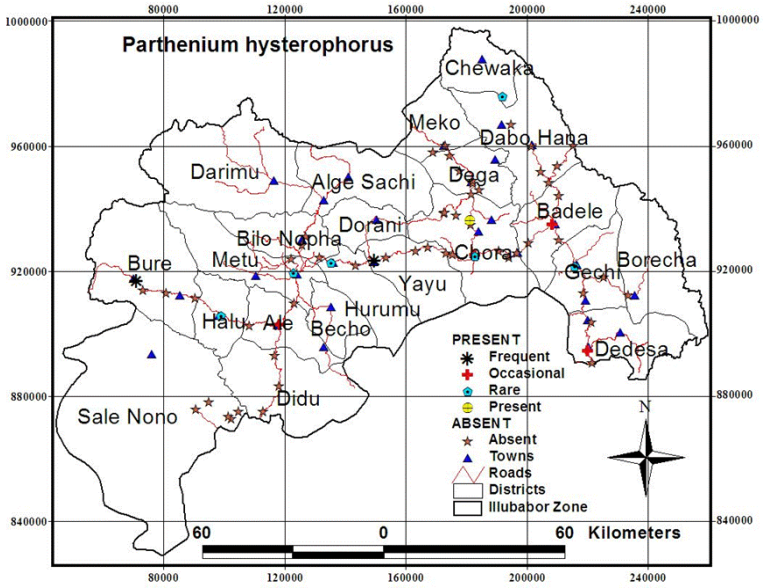

Figure 1. Abundance and distribution of *P. hysterophorus* in sampling locations in the Illu Ababora Zone, Oromia National Regional State.

almost all the IAPS were found infesting only roadsides, wasteland and around habitation in and/or near the towns (Table 2). However, high infestation of *C.vulgare* on rangeland in Meko and Dega District and invasion of *M. invisa* on rangeland in Bure District were also observed. Less abundance of the species in the zone may be due to recent introduction or due to absence of favorable condition for fast distribution and growth as the area is known by dense forest and rarely disturbed. The following five IAPS (that is, *P.hysterophorus, M. invisa, C. vulgare, S. dedymobotra* and *C. campestris*) were selected and presented because they are among the most serious invasives.

Parthenium hysterophorus

Of the total of waypoints taken, *P. hysterophorus* was observed on 13 waypoints (19%) which were at/near the towns of the Districts that is, Chora, Metu, Yayu, Ale, Bure, Dedesa, Gechi, Bedelle, Hurumu, Halu and Chawaqa. *P. hysterophorus* was observed to grow on roadsides and wasteland in towns. It was unevenly distributed in the Illu Ababora Zone (Figure 1) occurring only at towns and has not spread into cropland and rangeland. The result of biophysical survey revealed that *P. hysterophorus* was observed to spread from market area and roadside to wasteland and around habitations

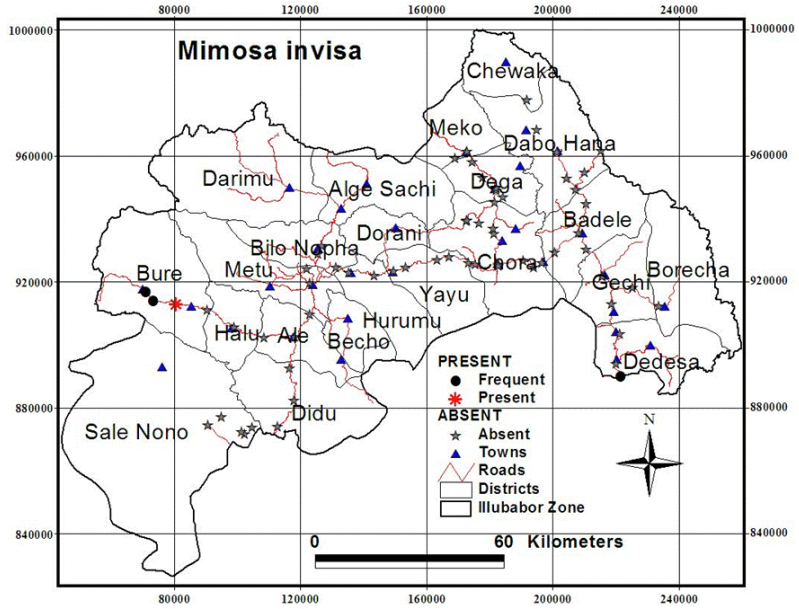

Figure 2. Abundance and distribution of *M. invisa* in sampling locations in the Illu Ababora Zone, Oromia National Regional State.

Figure 3. *Mimosa invisa* (A-Infestation on roadsides, B-Infestation in coffee plantation, C- Flower and D-Pods) in the Illu Ababora Zone of Oromia National Regional State.

within the towns. This shows that the capability of *P. hysterophorus* for further spread into cropland and rangeland of the Zone at which its effect can be severe and easily observed.

Mimosa invisa

M. invisa was recorded at 4 waypoints (6%) which are located in 2 Districts that is, Bure and Dedesa. Figure 2 depicted that the distribution of *M. invisa* was less in the Illu Ababora. The result of biophysical survey indicated that *M. invisa* was frequently spreading from Bure District to other Districts of the Zone, and grows on roadsides, rangeland and around the forest and coffee plantation (Figure 3) in Bure District while it was observed only on roadsides in Dedesa District. Infestation of *M. invisa* was severe on rangeland and around the forest forming an impenetrable layer.

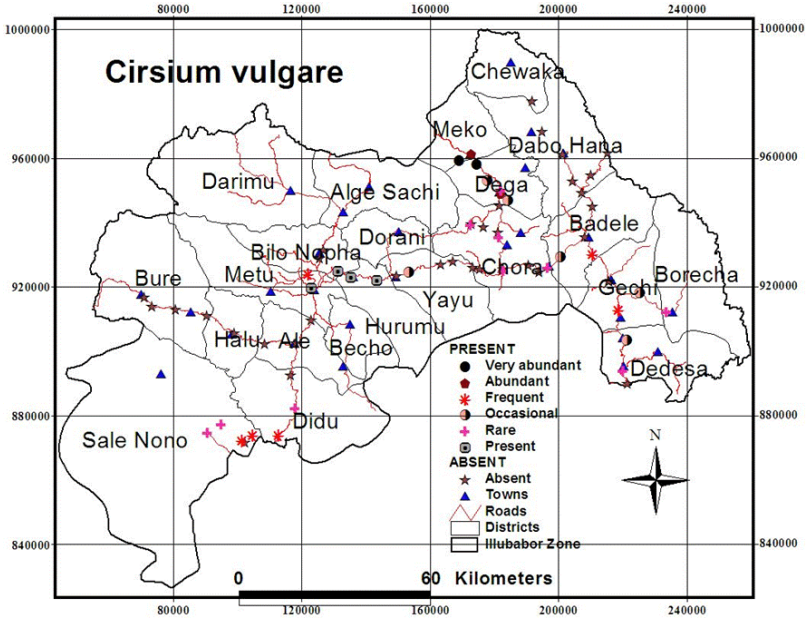

Figure 4. Abundance and distribution of *C. vulgare* in sampling locations in the Illu Ababora Zone, Oromia National Regional State.

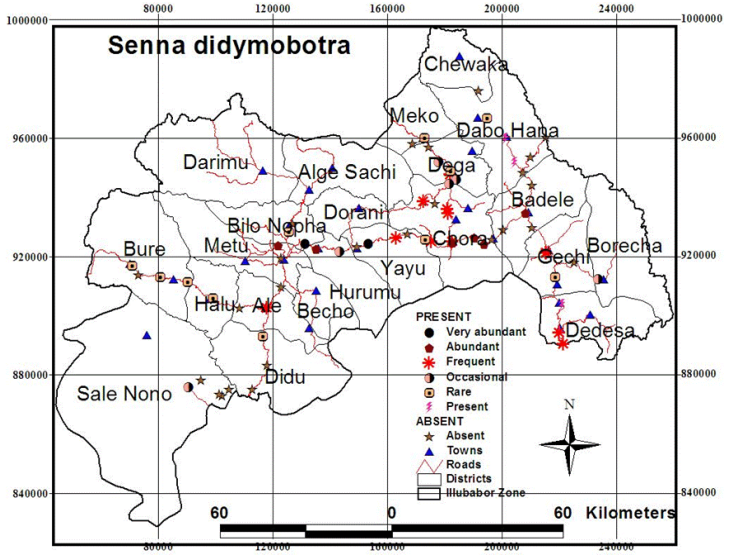

Figure 5. Abundance and distribution of *S. didymobotra* in sampling locations in the Illu Ababora Zone, Oromia National Regional State.

Cirsium vulgare

C. vulgare was observed on 30 waypoints (45%) of the total waypoints in thirteen Districts of the study area (Figure 4). As it was observed in Didu and Sale Nono Districts, *C. vulgare* grows on transformed land (that is, forest to arable land). The spread of the plant followed roadsides and it also grows on the wasteland in the towns. At District level *C. vulgare* was 'very abundant' in Meko, 'occasional' in Dega, and 'rare' in other Districts. High abundance of *C. vulgare* at Meko suggests that the species is more aggressive in open and frequently disturbed areas than in undisturbed areas.

Senna didymobotrya

Of the total of 67 waypoints *S. didymobotra* was observed on 40 waypoints (60%) which were both in urban and rural areas of the Districts (Figure 5). It was found in all the surveyed Districts of the Zone except

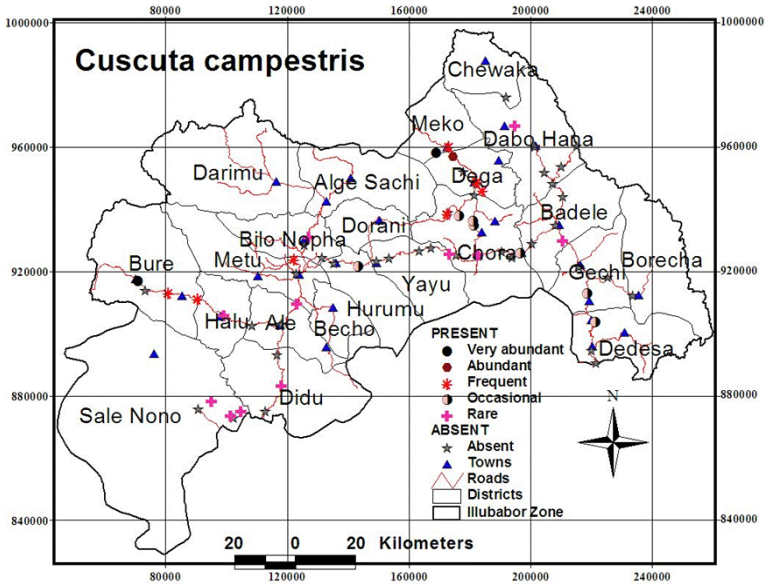

Figure 6. Abundance and distribution of *C. campestris* in sampling locations in the Illu Ababora Zone, Oromia National Regional State.

Chawaqa which was recently established in the Zone during 2003/2004 for resettlement of the people from western Hararghe. Distribution of *S. didymobotra* was localized spreading from town to rangeland following roadsides in all districts except in Bedele, Chora, Yayu and Hurumu Districts where high infestation on rangeland was observed.

Cuscuta campestris

High infestation of *C. campestris* was observed in Bure, Sale Nono, and Dega and Meko Districts of the Zone (Figure 6). Distribution of *C. campestris* was limited to the presence/absence of the host plants such as niger-seed, soybean and garden crops.

DISCUSSION

Invasive plants have entered and invading economical lands and water bodies in Ethiopia (EARO, 2003). Recent studies show that plant invaders are spreading to non-invaded areas and exerting negative impacts in Ethiopia. Having this information, this study was conducted to determine the IAPS composition, abundance and distribution in the Illu Ababora Zone. A total of sixteen IAPS (that is, *Acanthus pubescens, Argemone ochroleuca, Caesalpinia spp., Cirsium vulgare, Cuscuta campestris, Ipomeoa spp., Lantana camara, Mimosa invisa, Opuntia stricta, Parthenium hysterophorus, Psidium guajava, Senna didymobotra, S. occidentalis, Tapinanthus globiferus, Xanthium spinosum,* and *X. strumarium*) were observed in the Illu Ababora Zone. Of the species intercepted, *P. hystrophorus, L. camara and C. campestris* were the species that are considered emerging issue in Ethiopia (EARO, 2004b) while *M. invisa* was unknown in the country. These species were found with limited distribution on roadsides, wasteland and around habitation in the towns and had not moved to cropland and rangelands, except *C. campestris*.

This result agreed with Taye (2002) who reported that *P. hysterophorus* occurred in the towns, usually on roadsides, and vacant sites and grew only at irregular intervals. Similarly, Taye et al. (2007) reported that the low infestation of *P. hysterophorus* was found on the market area and wasteland of Bure and Darimu districts of the Illu Ababora zone. In another way, Taye (2002) reported that *P. hysterophorus* was detected as a major weed of crops in the northern and eastern parts of Ethiopia with infestation of greater than 20 plants per m^2 in some locations. Accordingly, the presence of the species in the zone suggests that the species may become well distributed and invade croplands in the Zone. High infestation of *C. vulgare* on rangeland found in Meko District clearly indicates that the plant has aggressively invaded the rangeland in the place. The study conducted elsewhere also reported that *C. vulgare* thrives on open agro-ecology and cannot withstand on deep shade, and is nearly absent if light is reduced to less than 40% of full sunlight (Feis, 1996). From the biophysical survey of this study, the reason why *C. vulgare* was very abundant in Meko seems to be the agro-ecology of the area.

The area was subjected to full sunlight because of the absence of dense forest unlike in the other Districts. In addition, the District had high amount of cattle that may cause overgrazing which can support invasive plants like *C. vulgare*. Similarly, Randall (2000) and Forcella et al.

(1994) reported that *C. vulgare* was a very widespread weed that can grow in a wide range of environments but was most troublesome in recently or repeatedly disturbed areas such as pastures, overgrazed rangelands, recently burned forests and forest clear-cuts, and along roads, ditches, and fences. This study has taken step in determining IAPS composition, abundance and distribution by waypoint data only on accessible roads in the zone at a specific time. It is believed that detailed long-term survey can generate information on the change in their abundance and distribution as well as their socio-economic impact in the zone. Therefore, the detailed assessment of the IAPS distribution and socio-economic impact should be done in the zone to develop the appropriate control measures.

ACKNOWLEDGEMENT

This study was funded by the Rural Capacity Building of Ethiopia and technically supported by the Removing Barriers to Invasive Plant Management in Africa Project. Therefore, we deeply acknowledge them for their great help. We would also like to express our thanks to Dr. S.K. Singh (Ambo University, Ethiopia), Mr. Rezene Fisieha (Ethiopian Institute of Agricultural Research) Mr. Berhanu Solomon (Environmental Protection Authority), Mr. Demeke Nigussie (Ethiopian Institute of Agricultural Research) and Dr. Dawit Alemu (Ethiopian Institute of Agricultural Research) for their consistent guidance throughout the study.

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